RECORDING MEDIUM HAVING DATA STRUCTURE FOR MANAGING REPRODUCTION OF MULTIPLE PLAYBACK PATH VIDEO DATA RECORDED THEREON AND RECORDING AND REPRODUCING METHODS AND APPARATUSES

BACKGROUND OF THE INVENTION

Field of the Invention

[0001]   The present invention relates to a recording medium having a data structure for managing reproduction of at least video data recorded thereon as well as methods and apparatuses for reproduction and recording.

Description of the Related Art

[0002]   The standardization of new high-density read only and rewritable optical disks capable of recording large amounts of high-quality video and audio data has been progressing rapidly and new optical disk related products are expected to be commercially available on the market in the near future. The Blu-ray Disc Rewritable (BD-RW) is one example of these new optical disks.

[0003]   Fig. 1 illustrates the file structure of the BD-RW. The file structure or data structure provides for managing the reproduction of the video and audio data recorded on the BD-RW. As shown, the data structure includes a root directory that contains at least one BDAV directory. The

BDAV directory includes files such as 'info.bdav', 'menu.tidx', and 'mark.tidx', a PLAYLIST subdirectory in which playlist files (*.rpls and *.vpls) are stored, a CLIPINF subdirectory in which clip information files (*.clpi) are stored, and a STREAM subdirectory in which MPEG2-formatted A/V stream clip files

5 (*.m2ts) corresponding to the clip information files are stored. In addition to illustrating the data structure of the optical disk, Fig. 1 represents the areas of the optical disk. For example, the general information file info.bdav is stored in a general information area or areas on the optical disk.

[0004]   Because the BD-RW data structure and disk format as

10 illustrated in Fig. 1 is well-known and readily available, only a brief overview of the file structure will be provided in this disclosure.

[0005]   As alluded to above, the STREAM directory includes MPEG2-formatted A/V stream files called clips. The STREAM directory may also include a special type of clip referred to as a bridge-clip A/V stream file. A

15 bridge-clip is used for making seamless connection between two or more presentation intervals selected in the clips, and generally have a small data size compared to the clips. The A/V stream includes source packets of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number,

20 which is generally a sequentially assigned number that serves as an address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have the

same PID.

[0006] The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence

5 information, program information and timing information. The sequence information describes the arrival time basis (ATC) and system time basis (STC) sequences. For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and

10 the PID of the transport packets in each sequence. A sequence of source packets in which the contents of a program is constant is called a program sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

15 [0007] The timing information is referred to as characteristic point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number).

20 [0008] The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The

playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies

5 playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

[0009]   A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips.

10 Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

15   [0010]   The info.bdav file is a general information file that provides general information for managing the reproduction of the A/V stream recorded on the optical disk. More specifically, the info.bdav file includes, among other things, a table of playlists that identifies the files names of the playlist in the PLAYLIST directory of the same BDAV directory.

20   [0011]   The menu.tidx, menu.tdt1 and menu.tdt2 files store information related to menu thumbnails. The mark.tidx, mark.tdt1 and mark.tdt2 files store information that relates to mark thumbnails. Because these files are not particularly relevant to the present invention, they will not

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be discussed further.

[0012]   The standardization for high-density read-only optical disks such as the Blu-ray ROM (BD-ROM) is still under way. An effective data structure for managing reproduction of video and audio data recorded on the

5 high-density read-only optical disk such as a BD-ROM is not yet available.

SUMMARY OF THE INVENTION

[0013]   The recording medium according to the present invention includes a data structure for managing reproduction of at least multiple playback path video data recorded on the recording medium.

[0014]   According to one exemplary embodiment, the recording

10 medium includes multiple playback path video data of a title. A playlist directory area of the recording medium stores a playlist directory including a plurality of playlist files. Each playlist file identifies a portion of the multiple playback path video data and at least a portion of the playlist files are associated with different playback paths. At least one navigation information

15 area stores navigation information at least providing information on one playback path. In one exemplary embodiment, the different playback paths of the title are different stories of the title.

[0015]   In another exemplary embodiment, the recording medium includes a playlist directory area storing a playlist directory including

20 a plurality of playlists. At least a number of the playlists are divided into groups and each group is associated with a different playback path. In a

further aspect of this embodiment, at least one navigation information area of the recording medium stores navigation information at least providing information on one playback path. In one exemplary embodiment, the different playback paths of the title are different stories of the title.

5   [0016]   According to an exemplary embodiment associated with any of the described embodiments, a group of playlist files is associated with each playback path. According to a further associated embodiment, the navigation information at least provides information linking one playlist file to another playlist file in the same playback path. In one exemplary embodiment, 10 the navigation information indicates a next playlist file to playback after a particular playlist file is played back.

[0017]   According to another exemplary embodiment associated with any of the described embodiments, a data area of the recording medium stores clips of the multiple playback path video data, and the video data for 15 each playback path is stored in a different clip.

[0018]   The present invention further provides apparatuses and methods for recording and reproducing the data structure according to the' present invention. For example, in one method of reproduction, at least one playlist associated with a user selected playback path is reproduced based on 20 navigation information recorded on the recording medium.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]   The above features and other advantages of the present

invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0020]   Fig. 1 illustrates the prior art file or data structure of a rewritable optical disk according to the Blu-ray Disc Rewritable (BD-RW)
5 standard;

[0021]   Figs. 2 illustrates an exemplary embodiment of a recording medium file or data structure according to the present invention;

[0022]   Fig. 3 illustrates an example of a recording medium having the data structure of Fig. 2 stored thereon;

10   [0023]   Fig. 4 illustrates a first embodiment of managing multiple playback path data streams in accordance with the present invention;

[0024]   Fig. 5 illustrates a schematic diagram of an embodiment of an optical disk recording and reproduction apparatus of the present
15 invention;

[0025]   Figs. 6 illustrates a second embodiment of managing multiple playback path data streams in accordance with the present invention;

[0026]   Fig. 7 illustrates a third embodiment of managing
20 multiple playback path data streams in accordance with the present invention;

[0027]   Fig. 8 illustrates a fourth embodiment of managing multiple playback path data streams in accordance with the present

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invention;

[0028]   Fig. 9 illustrates a fifth embodiment of managing multiple playback path data streams in accordance with the present invention;

5   [0029]   Fig. 10 illustrates a sixth embodiment of managing multiple playback path data streams in accordance with the present invention;

[0030]   Fig. 11 illustrates a seventh embodiment of managing multiple playback path data streams in accordance with the present 10 invention; and

[0031]   Fig. 12 illustrates an eighth embodiment of managing multiple playback path data streams in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032]   In order that the invention may be fully understood, 15 preferred embodiments thereof will now be described with reference to the accompanying drawings.

[0033]   A high-density optical disk, for example, a Blu-Ray ROM (BD-ROM) in accordance with the invention may have a file or data structure for managing reproduction of video and audio data as shown in Fig. 2. Many 20 aspects of the data structure according to the present invention shown in Fig. 2 are similar to that of the BD-RW standard discussed with respect to Fig 1.

As such these aspects will not be described in great detail.

[0034]   As shown in Fig. 2, the root directory contains at least one DVP directory. The DVP directory includes a general information file info.dvp, menu files menu.tidx, menu.tdt1 among others, a PLAYLIST

5   directory in which playlist files (e.g., real (*.rpls) and virtual (*.vpls)) are stored, a CLIPINF directory in which clip information files (*.clpi) are stored, and a STREAM directory in which MPEG2-formatted A/V stream clip files (*.m2ts), corresponding to the clip information files, are stored.

[0035]   The STREAM directory includes MPEG2-formatted A/V

10 stream files called clips. The STREAM directory may also include a special type of clip referred to as a bridge-clip A/V stream file. A bridge-clip is used for making seamless connection between two or more presentation intervals selected in the clips, and generally have a small data size compared to the clips. The A/V stream includes source packets of video and audio data. For

15 example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number, which is generally a sequentially assigned number that serves as an address for accessing the source packet. Transport packets include a packet identifier (PID). The use of the PID in the present invention will be described in greater detail below.

20 [0036]   The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing information. The sequence

information describes the arrival time basis (ATC) and system time basis (STC) sequences. For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and

5 the PID of the transport packets in each sequence. A sequence of source packets in which the contents of a program is constant is called a program sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

10 **[0037]** The timing information is referred to as characteristic point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number).

15 **[0038]** The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist,

20 and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies playitems, each playitem points to a clip or portion thereof and identifies the

clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

[0039]   A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips.
5 Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

10   [0040]   The info.dvp file is a general information file that provides general information for managing the reproduction of the A/V streams recorded on the optical disk.

[0041]   In addition to illustrating the data structure of the recording medium according to an embodiment of the present invention, Fig.
15 2 represents the areas of the recording medium. For example, the general information file is recorded in one or more general information areas, the playlist directory is recorded in one or more playlist directory areas, each playlist in a playlist directory is recorded in one or more playlist areas of the recording medium, etc. Fig. 3 illustrates an example of a recording medium
20 having the data structure of Fig. 2 stored thereon. As shown, the recording medium includes a file system information area, a data base area and an A/V stream area. The data base area includes a general information file and playlist information area and a clip information area. The general information

file and playlist information area have the general information file recorded in a general information file area thereof, and the PLAYLIST directory and playlist files recorded in a playlist information area thereof. The clip information area has the CLIPINFO directory and associated clip information

5 files recorded therein. The A/V stream area has the A/V streams for the various titles recorded therein.

[0042] Video and audio data are typically organized as individual titles; for example, different movies represented by the video and audio data are organized as different titles. Furthermore, a title may be

10 organized into individual chapters in much the same way a book is often organized into chapters.

[0043] Because of the large storage capacity of the newer, high-density recording media such as BD-ROM optical disks, different titles, various versions of a title or portions of a title may be recorded, and therefore,

15 reproduced from the recording media. For example, video data representing different camera angles may be recorded on the recording medium. As another example, versions of title or portions thereof associated with different languages may be recorded on the recording medium. As a still further example, a director's version and a theatrical version of a title may be recorded

20 on the recording medium. Or, an adult version, young adult version and young child version (i.e., different parental control versions) of a title or portions of a title may be recorded on the recording medium. Each version represents a different reproduction path, and the video data in these

instances is referred to as multiple reproduction path video data. It will be appreciated that the above examples of multiple reproduction path video data are not limiting, and the present invention is applicable to any type or combination of types of multiple reproduction path video data.

5   **[0044]**   Also, a title may have different possible stories forming a portion of the title. This is particularly true of interactive titles where the playback path of portions of the title (e.g., the story paths for a particular portion of a title) depends on user input. Accordingly, these multi-story titles may have numerous playback paths depending on the user input. As will be

10 described in detail below with respect to embodiments of the present invention, the data structures according to the present invention include story or navigation information for managing and controlling the reproduction of multiple playback paths (e.g., stories) associated with the one title.

15   **[0045]**   For example, in one embodiment the navigation information includes concatenation information of previous and next playitems (Prev_PI and Next_PI) and concatenation information of previous and next playlists (Prev_PL and Next_PL). As another example, path number information for indicating the paths of the multiple playback paths may be

20 recorded in the playlist files of the title.

     [0046]   Fig. 4 illustrates a first embodiment of managing multi-story data streams in accordance with the data structure of Fig. 2. At least one clip file contained and recorded in the file structure of the BD-ROM

is linked to a plurality of playlists (PL1, PL2, PL3, ...), for example, and managed with the a title. A/V streams of multiple stories contained and recorded in the clip file are recorded in the form of TPs based on MPEG 2.

[0047]   Different PIDs for identifying each story are recorded in

5   the TPs. Stated another way, the TPs associated with different stories have different PIDs. As shown in Fig. 4, for example, Video_PID = A and Audio_PID = P are contained and recorded in first transport packets TP1 of a first story, which is contained and recorded in the clip file. Video_PID = B and Audio_PID = R are contained and recorded in second transport packets TP2 of a second

10 story, which is contained and recorded in the clip file. The first and second transport packets TP1 and TP2 of the first and second stories are sequentially and seamlessly recorded in a data recording area of the BD-ROM such that the first and second transport packets TP1 and TP2 can be seamlessly reproduced.

15   [0048]   Fig. 4 further shows that concatenation information of the previous and next playlists (Prev_PL and Next_PL) for designating the order of reproduction of multiple playback paths may be contained and recorded as navigation information in the plurality of playlists (PL1, PL2, PL3, ...) linked to the clip file. Namely, the navigation information links playlists

20 together. During playback, this information indicates the next playlist to playback after playback of a particular playlist. The navigation information for playlists of a particular story or playback path creates a linked group of playlists associated with that playback path. Fig. 3 illustrates one navigation

area of the recording medium storing this navigation information; however, it will be understood that numerous navigation areas may be provided.

[0049]   Fig. 5 illustrates a schematic diagram of an embodiment of an optical disk recording and reproducing apparatus according to the

5   present invention. As shown, an AV encoder 9 receives and encodes audio and video data. The AV encoder 9 outputs the encoded audio and video data along with coding information and stream attribute information. A multiplexer 8 multiplexes the encoded audio and video data based on the coding information and stream attribute information to create, for example, an

10   MPEG-2 transport stream. A source packetizer 7 packetizes the transport packets from the multiplexer 8 into source packets in accordance with the audio/video format of the optical disk. As shown in Fig. 5, the operations of the AV encoder 9, the multiplexer 8 and the source packetizer 7 are controlled by a controller 10. The controller 10 receives user input on the recording

15   operation, and provides control information to AV encoder 9, multiplexer 8 and the source packetizer 7. For example, the controller 10 instructs the AV encoder 9 on the type of encoding to perform, instructs the multiplexer 8 on the transport stream to create, and instructs the source packetizer 7 on the source packet format. The controller 10 further controls a drive 3 to record the

20   output from the source packetizer 7 on the optical disk.

[0050]   The controller 10 also creates the navigation and management information for managing reproduction of the audio/video data being recorded on the optical disk. For example, based on information

received via the user interface (e.g., instruction set saved on disk, provided over an intranet or internet by a computer system, etc.) the controller 10 controls the drive 3 to record the data structure of Figs. 2-5 on the optical disk.

5   **[0051]**   During reproduction, the controller 10 controls the drive 3 to reproduce this data structure. Based on the information contained therein, as well as user input received over the user interface (e.g., control buttons on the recording and reproducing apparatus or a remote associated with the apparatus), the controller 10 controls the drive 3 to reproduce the

10   audio/video source packets from the optical disk. Namely, the controller 10 selects and reproduces a clip file corresponding to an arbitrary title in response to the user's reproduction request. After searching for and referring to the navigation information contained in the playlist files linked to the clip file, the controller 10 can sort the A/V streams of playback paths

15   selected and designated by the user and perform concatenated reproduction of a set of multiple stories as discussed previously.

     [0052]   For example, the user input may specify a story (or playback path to reproduce). This user input may be specified, for example, via a menu based graphical user interface preprogrammed into the controller

20   10. Using the user input and navigation information reproduced from the optical disk, the controller 10 controls the reproduction of the playback path.

     [0053]   For example, to select a particular playback path, the PIDs for the TPs are examined by the controller 10 to determine the number of

stories or playback paths, and the user is requested which path to reproduce. This path information may be augmented to provide more meaningful information regarding the reproduction path to reproduce. During reproduction, the first playlist associated with the selected path (e.g.,

5   associated with TPs having the selected PID) is reproduced. The navigation information then indicates the next playlist to reproduce in the group of playlists forming the selected playback path.

[0054]   The reproduced packets are received by a source depacketizer 4 and converted into a data stream (e.g., an MPEG-2 transport

10 packet stream). A demultiplexer 5 demultiplexes the data stream into encoded video and audio data. An AV decoder 6 decodes the encoded video and audio data to produce the original audio and video data that was feed to the AV encoder 9. During reproduction, the controller 10 controls the operation of the source depacketizer 4, demultiplexer 5 and AV decoder 6. The controller 10

15 receives user input on the reproducing operation, and provides control information to AV decoder 6, demultiplexer 5 and the source packetizer 4. For example, the controller 10 instructs the AV decoder 9 on the type of decoding to perform, instructs the demultiplexer 5 on the transport stream to demultiplex, and instructs the source depacketizer 4 on the source packet

20 format.

[0055]   While Fig. 5 has been described as a recording and reproducing apparatus, it will be understood that only a recording or only a reproducing apparatus may be provided using those portions of Fig. 5

providing the recording or reproducing function.

[0056]   Fig. 6 illustrates a second embodiment of managing multiple playback path data streams in accordance with the present invention. The embodiment of Fig. 6 is the same as the embodiment of Fig. 4, except that

5   the playlists also include path number information. The path number information is included in addition to or instead of the navigation information discussed above with respect to the embodiment of Fig. 4. The path number information indicates the playback path or paths with which the playlist is associated. Namely, each playback path is assigned a path number, and the

10 path number information for a playlist provides the path number of playback path with which the playlist is associated. In this manner, the path number information may indicate with which story each playlist is associated.

[0057]   The recording and reproducing apparatus of Fig. 5 operates in the same manner with respect to the embodiment Fig. 6 as was

15 described above with respect to the embodiment of Fig. 4. However, with the embodiment of Fig. 6, the controller 10 may determine the playback paths from the path number information.

[0058]   Fig. 7 illustrates a third embodiment of managing the multiple playback path data streams in accordance with the present invention.

20 The embodiment of Fig. 7 is the same as the embodiment of Fig. 4, except for how the transport packets are recorded in the clip file. As shown in Fig. 7, the first and second transport packets TP1 and TP2 are each divided into groups of a predetermined size, and the groups are interleaved. The group size is

established so that seamless playback of each playback path is possible even though the groups of transport packets for different playback paths (e.g., different stories) are interleaved.

[0059]   That is, as shown in Fig. 7, in the clip file, there are

5   interleaved recording areas for transport packet groups Story 1-1, Story 1-2, Story 1-3, ... associated with the first story. Each group has the predetermined size and includes first transport packets TP1s associated with the first story. Also, there are interleaved recording areas for transport packet groups Story 2-1, Story 2-2, Story 2-3, ... associated with the second story.

10   Each group has the predetermined size and includes second transport packets TP2s associated with the second story.

[0060]   As described in conjunction with Fig. 4-5, the VDP system 3 of the optical disk apparatus selects and reproduces a clip file corresponding to an arbitrary title in response to the user's reproduction

15   request.   After searching for and referring to the navigation information contained in the playlist files linked to the clip file, the VDP system 3 can sort the A/V streams of stories selected and designated by the user and perform concatenated reproduction of a set of multiple playback paths as discussed previously.

20   [0061]   Fig. 8 illustrates a fourth embodiment of managing multiple playback path data streams in accordance with the present invention. The embodiment of Fig. 8 is the same as the embodiment of Fig. 7, except that the playlists also include path number information. The path number

information is included in addition to or instead of the navigation information discussed above with respect to the embodiment of Fig. 7. The path number information indicates the playback path or paths with which the playlist is associated. Namely, each playback path is assigned a path number, and the

5   path number information for a playlist provides the path number of playback path with which the playlist is associated. In this manner, the path number information indicates with which playback path each playlist is associated.

    [0062]   The recording and reproducing apparatus of Fig. 5 operates in the same manner with respect to the embodiment of Fig. 8 as was

10   described above with respect to the embodiment of Fig. 7. However, with the embodiment of Fig. 8, the controller 10 may determine the playback paths from the path number information.

    [0063]   Fig. 9 illustrates a fifth embodiment of managing the multiple playback path data streams in accordance with the present invention.

15   The embodiment of Fig. 9 is the same as the embodiment of Fig. 4, except that the transport packets associated with different playback paths are not recorded in the same clip file. Instead, the transport packets associated with different playback paths (e.g., different stories) are recorded in different clip files.

20   **[0064]**   As shown in Fig. 9, first and second clip files 1 and 2, in the file structure of the BD-ROM, are linked to the plurality of playlists (PL1, PL2, PL3, ...) of a title. Moreover, the first transport packets TP1 associated with the first story and having Video_PID = A and Audio_PID = P are recorded

in the first clip file, while the second transport packets TP2 associated with the second story and having Video_PID = B and Audio_PID = R are recorded the second clip file.

[0065]   As described in conjunction with Fig. 5, the VDP system

5   3 of the optical disk apparatus selects and reproduces a clip file corresponding to an arbitrary title in response to the user's reproduction request.   After searching for and referring to the navigation information contained in the playlist files linked to the clip file, the VDP system 3 can sort the A/V streams of stories selected and designated by the user and perform

10 concatenation reproduction of a set of multiple playback paths as described with respect to Fig. 4.

[0066]   Fig. 10 illustrates a sixth embodiment of managing multiple playback path data streams in accordance with the present invention. The embodiment of Fig. 10 is the same as the embodiment of Fig. 9, except

15 that the playlists also include path number information. The path number information is included in addition to or instead of the navigation information discussed above with respect to the embodiment of Fig. 9. The path number information indicates the playback path or paths with which the playlist is associated. Namely, each playback path is assigned a path number, and the

20 path number information for a playlist provides the path number of playback path with which the playlist is associated. In this manner, the path number information indicates with which playback path each playlist is associated.

[0067]   The recording and reproducing apparatus of Fig. 5

operates in the same manner with respect to the embodiment Fig. 10 as was described above with respect to the embodiment of Fig. 9. However, with the embodiment of Fig. 10, the controller 10 may determine the playback paths from the path number information.

5   [0068]   Fig. 11 illustrates a seventh embodiment of the method for managing the multiple playback path data streams in accordance with the present invention. The embodiment of Fig. 11 is the same as the embodiment of Fig. 9, except for how the transport packets are recorded on the recording medium. As shown in Fig. 11, the first and second transport packets TP1 and

10   TP2 are each divided into groups of a predetermined size, and the groups are interleaved. The group size is established so that seamless playback of each playback path is possible even though the groups of transport packets for different playback paths (e.g., different stories) are interleaved.

[0069]   That is, as shown in Fig. 11, in the clip file, there are

15   interleaved recording areas for transport packet groups Story 1-1, Story 1-2, Story 1-3, ... associated with the first story. Each group has the predetermined size and includes first transport packets TP1s associated with the first story. Also, there are interleaved recording areas for transport packet groups Story 2-1, Story 2-2, Story 2-3, ... associated with the second story.

20   Each group has the predetermined size and includes second transport packets TP2s associated with the second story.

[0070]   As described in conjunction with Fig. 4-5, the VDP system 3 of the optical disk apparatus selects and reproduces a clip file

corresponding to an arbitrary title in response to the user's reproduction request. After searching for and referring to the navigation information contained in the playlist files linked to the clip file, the VDP system 3 can sort the A/V streams of stories selected and designated by the user and perform 5 concatenated reproduction of a set of multiple stories as discussed previously.

[0071] Fig. 12 illustrates an eighth embodiment of managing multiple playback path data streams in accordance with the present invention. The embodiment of Fig. 12 is the same as the embodiment of Fig. 11, except 10 that the playlists also include path number information. The path number information is included in addition to or instead of the navigation information discussed above with respect to the embodiment of Fig. 11. The path number information indicates the playback path or paths with which the playlist is associated. Namely, each playback path is assigned a path number, and the 15 path number information for a playlist provides the path number of playback path with which the playlist is associated. In this manner, the path number information indicates with which story each playlist is associated.

[0072] The recording and reproducing apparatus of Fig. 5 operates in the same manner with respect to the embodiment of Fig. 12 as was 20 described above with respect to the embodiment of Fig. 11. However, with the embodiment of Fig. 12, the controller 10 may determine the playback paths from the path number information.

[0073] As will be appreciated, the clip files (*.m2ts) in the

above-described embodiments are also linked to one or more playitems in each playlist. In this case, concatenation information of the previous and next playitems (Prev_PI and Next_PI) for designating the order of reproduction of the multiple stories or the path number information may be

5 contained and recorded in the playlist files.

[0074]   Also, the present invention is not limited to having a single title recorded on the recording medium. An additional title directory and an additional title file may be recorded in the file structure of the present invention.

10   [0075]   As apparent from the above description, the present invention provides for managing multiple playback path data streams of a high-density optical disk. As such the reproducing method and apparatus of the present invention can quickly and correctly sort data streams of playback paths selected and designated by a user, and reproduce the sorted

15 data streams.

[0076]   While the invention has been disclosed with respect to a limited number of embodiments, those skilled in the art, having the benefit of this disclosure, will appreciate numerous modifications and variations there from. For example, while described with respect to a Blu-ray ROM optical disk,

20 the present invention is not limited to this standard of optical disk or to optical disks. It is intended that all such modifications and variations fall within the spirit and scope of the invention.